Remarks

Claims 1-15, 24-27, 30 and 31 are pending. With this Response claim 24 is amended and claim 30 is canceled. Upon entry of the current amendments, claims 1-15, 24-27, and 31 are pending.

Applicants submit that the claim amendments are fully supported by the application as originally filed (discussed below) and that such amendments do not present new matter.

Applicants respectfully request reconsideration and further examination of the application in view of the amendments above and remarks below.

Claim Amendments Should Be Entered After Final

The amendment to claim 24 and cancellation of claim 30 presents the claims in better form for appeal, thereby making entry of the amendments proper.

Independent claim 24 is amended to incorporate a feature described in the specification and recited in dependent claim 30 so as to remove the §102 rejection based on Lu and, therefore, present the claim in better form for appeal. Claim 24 is also amended to clarify the claim language from "apparatus" to "system" so there is proper antecedent basis and, therefore, present the claim in better form for appeal.

Dependent claim 30 is canceled to conform to the amendment of base claim 24.

Accordingly, it is respectfully requested that the amendment to claim 24 and cancellation of claim 30 be entered after final.

Claim Rejections - 35 U.S.C. §102

The Mekias Reference

Claims 1-8 stand rejected under 35 U.S.C. §102 (e) as being anticipated by Mekias (U.S. Pub. No. 2003/0075555).

Applicants respectfully traverse this rejection of claims 1-8 because, e.g., Mekias does not teach each and every element as set forth in independent claim 1. More specifically, the Mekias reference does not teach the control feature recited in independent claim 1.

MPEP 2131 properly indicates that to anticipate a claim, the reference must teach each and every element as set forth in the claim.

Claim 1 features a spin-coating system that recites "a pressure sensor that measures pressure of the process solution in the dispense line at a time related to a step of dispensing the process solution, to control timing of a subsequent spin-coating process step." An example of such a time related to a step of dispensing a process solution includes the end of dispensing a photoresist solution (see the specification at, e.g., page 29, lines 1-25). The end of photoresist solution dispense as determined by measuring pressure of the photoresist solution can be used to control the timing of a subsequent spin-coating process step such as, e.g., moving a dispenser and/or changing the turntable spin speed (e.g., changing the spin speed to casting speed) (see the specification at, e.g., page 30, lines 25-31).

Mekias does not teach a pressure sensor that measures pressure of the process solution in the dispense line at a time related to a step of dispensing the process solution, to control timing of a subsequent spin-coating process step.

In general, the Mekias reference relates to a high precision fluid dispensing apparatus (i.e., pump) (see Mekias at, e.g., paragraphs 0001 and 0005). A Mekias pump can include, e.g., one or more process chambers that allow a process fluid to pass through the pump and a control chamber that includes a control fluid to control the volume a process chamber (see Mekias at, e.g., paragraphs 0018 and 0019).

At paragraph 0022, Mekias describes controlling the pressure of the control fluid. Mekias also describes regulating the pressure of control fluid in Figs. 3 and 4 with regulator 44 (see Mekias at paragraphs 0035 and 0036). Such control would include measuring the pressure of the control fluid to control the pressure of the control fluid. However, measuring the pressure of the control fluid to control the pressure of the control fluid does not necessarily mean that the pressure of the process fluid is being measured.

At paragraph 0023, Mekias describes using pressure sensors to measure pressure for feedback control of control fluid pressure or process fluid pressure. Feedback control is generally well-known to involve measuring an output parameter of a process (e.g., fluid pressure), comparing the measured value to an expected value, making a decision

based on the comparison, and, depending on the decision, actuating a device to control the input process parameter (e.g., fluid pressure) (see, e.g., Ogunnaike et al., Process Dynamics, Modeling, and Control, at pages 17 and 18 (1994) (copy enclosed herewith)). However, feedback control does not necessarily measure a process parameter (e.g., fluid pressure) and control the timing of a subsequent process step.

As mentioned above, paragraph 0023 of the Mekias reference specifically describes using pressure sensors for feedback control of control fluid pressure or process fluid pressure. So, for example, such feedback control of process fluid pressure would involve measuring the process fluid pressure at an "output" point, comparing the measured process fluid pressure to an expected process fluid pressure, making a decision based on the comparison, and, depending on the decision, actuating a device at an "input" point to control the process fluid pressure. Such a feedback control system disclosed by Mekias does not necessarily measure the pressure of process solution to control timing of a subsequent spin-coating process step as claimed such as, e.g., moving a dispenser and/or changing the turntable spin speed.

Accordingly, it is respectfully requested that the rejection of claims 1-8 under 35 U.S.C. §102 (e) as being anticipated by Mekias, be withdrawn.

The Lu Reference

Claims 24-27 stand rejected under 35 U.S.C. 102(e) as being anticipated by Lu (US 6,098,650).

Applicants overcome this rejection by amending independent claim 24 to feature a pressure sensor that measures pressure of the process solution during process solution dispense to generate a measured pressure profile and compares the measured pressure profile to an expected pressure profile to identify a difference between the measured pressure profile and the expected pressure profile to detect a malfunction in the system. Support for this amendment can be found throughout the specification as originally filed, e.g., at page 23, lines 3-25.

The pressure profile feature incorporated into independent claim 24 by amendment was previously recited in dependent claim 30. Claim 30 was not rejected

under 35 U.S.C. 102(e) as being anticipated by Lu. Hence, Applicants respectfully submit that such amendment to independent claim 24 overcomes this rejection.

Accordingly, it is respectfully requested that the rejection of claims 24-27 under 35 U.S.C. 102(e) as being anticipated by Lu, be withdrawn.

Claim Rejections - 35 U.S.C. §103

DeSimone et al. in view of Hayes et al.

Claims 9-15 stand rejected under 35 U.S.C. §103(a) as being unpatentable over DeSimone et al. (U.S. Pat. No. 6,383,289) in view of Hayes et al. (U.S. Pat. No. 6,494,953).

The Office Action maintains the rejection set forth in the non-final Office Action mailed August 30, 2005, without commenting on Applicants' arguments that were subsequently filed in a Response on November 30, 2005.

Applicants maintain said arguments filed on November 30, 2005, and submit that such arguments are fully responsive to this rejection of the outstanding Office Action.

Accordingly, it is respectfully requested that the rejection of claims 9-15 under 35 U.S.C. §103(a) as being unpatentable over DeSimone et al. in view of Hayes et al., be withdrawn.

The Lu Reference

Claims 30 and 31 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Lu.

As discussed above, the pressure profile feature of claim 30 was incorporated into base claim 24.

Applicants submit that the Lu reference does not teach, motivate, or suggest the profile feature of amended claim 24.

Claim 24 recites a spin-coating system having, *inter alia*, a pressure sensor that "that measures pressure of the process solution during process solution dispense to generate a measured pressure <u>profile</u> and compares the measured pressure <u>profile</u> to an

expected pressure profile to identify a difference between the measured pressure profile and the expected pressure profile to detect a malfunction in the system." (Underlining added for emphasis).

Generating a measured pressure profile is unique because a profile can be used to detect particular malfunctions. For example, an area under a measured pressure profile curve can be proportional to the volume of process solution actually dispensed and can therefore be compared to an expected pressure profile and used as a cross-check for pump operation (see the specification at, e.g., page 23, lines 10-13). As another example, a measured pressure profile can be compared to an expected pressure profile and used to detect slight changes in time (drifting) of a pressure value at a particular time during solution dispense (see the specification at, e.g., page 23, lines 19-23).

The Lu reference does not teach the pressure profile feature of amended claim 24. Indeed, the pressure profile feature (previously presented in dependent claim 30) was not rejected under §102 based on the Lu reference.

Lu describes a pressure sensing apparatus that can be used in a solution transportation system (see Lu at Figs. 3A-3C and 5, and related text). The sensing apparatus illustrated in Figs 3A-3C of Lu includes a container 52, a diaphragm 44, a micro-switch 46, and an output terminal 50. When movement of the diaphragm 44 reaches a trigger limit due to a relatively high pressure in container 52, micro-switch 46 is switched on and an electrical signal is created by terminal 50 (see Lu at col. 4, lines 2-11, and Fig. 4A). When the pressure in container 52 is below the trigger limit, the micro-switch is switched off (see Lu at col. 4, line 24). Lu does not describe generating a measured pressure profile. Moreover, a micro-switch such as that described by Lu does not necessarily generate a measured pressure profile. Such micro-switches are typically on-off in nature, as described by Lu. That is, the micro-switch simply turns on when a trigger limit is achieved and simply turns off when below the trigger limit.

The Lu reference does not motivate or suggest the pressure profile feature of claim 24. The Lu reference describes a micro-switch for merely switching on or off so as to identify whether a trigger limit is present or not present. According to the Lu reference, a micro-switch is perfectly acceptable to identify whether a trigger limit is

present or not present. There is no reason indicated in the Lu reference for generating a measured pressure profile according to claim 24.

Accordingly, it is respectfully requested that the rejection of claims 30 and 31 under 35 U.S.C. §103(a) as being unpatentable over Lu, be withdrawn.

Conclusion

In view of these amendments and remarks, it is respectfully submitted that the above-identified application is in condition for allowance.

The Examiner is invited to contact the undersigned, at the Examiner's convenience, should the Examiner have any questions regarding this communication or the present patent application.

Respectfully Submitted,

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To Anna and "th
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To decades of superb
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of the principles and practice of control system
ıpter 2.

tem Hardware Elements

ıts required for the realization of the control system's *, decision making, and corrective action implementation* following categories: *sensors, controllers, transmitters,* *:nts.*

Sensors

acquiring information about the status of the process arried out by *sensors* (also called *measuring devices* or nost process control applications, the sensors are usually :, temperature, liquid level, flow, and composition ›ical examples are: *thermocouples* (for temperature *:rential pressure cells* (for liquid level measurements), *phs* (for composition measurements), *etc.*

Controllers

and hence the "heart" of the control system, is the rdware element with "built-in" capacity for performing ; some form of "intelligence."
ırdware may be *pneumatic* in nature (in which case it ls), or it may be *electronic* (in which case, it operates on lectronic controllers are more common in more modern ıtrol applications.
ınd electronic controllers are limited to fairly simple shall have cause to discuss more fully later. When more ations are required, the *digital computer* is usually used as

Transmitters

ıtion acquired by the sensor gets to the controller, and the :ets back to the process, is the responsibility of devices :. Measurement and control signals may be transmitted as or as *electrical signals*. Pneumatic transmitters are er, and electrical ones for the latter.

Final Control Elements

ts have the task of actually implementing, on the process, l issued by the controller. Most final control elements are

In transmitting information back and forth between the process and the controller, the need to *convert* one type of signal to another type is often unavoidable. For example, it will be necessary to convert the electrical signal from an electronic controller to a pneumatic signal needed to operate a control valve. The devices used for such signal transformations are called *transducers*, and as will be further discussed in Chapter 2, various types are available for various signal transformations.

Also, for computer control applications, it is necessary to have devices known as *analog-to-digital* (A/D) and *digital-to-analog* (D/A) *converters*. This is because, as will be elaborated further in Chapter 2, while the rest of the control system operates on *analog* signals (electric voltage or pneumatic pressure), the computer operates *digitally*, giving out, and receiving, only binary numbers. A/D converters make the process information available in recognizable form to the computer, while the D/A converters make the computer commands accessible to the process.

1.4.2 Control System Configuration

Depending primarily upon the structure of the decision-making process in relation to the information-gathering and decision-implementation ends, a process control system can be configured in several different ways. Let us introduce some of the most common configurations.

Feedback Control

The control system illustrated in Figure 1.12 operates by *feeding* process output information *back* to the controller. Decisions based on such "fed back" information is then implemented on the process. This is known as a *feedback control structure*, and it is one of the simplest, and by far the most common, control structures employed in chemical process control. It was introduced for the furnace example in Figure 1.6(a).

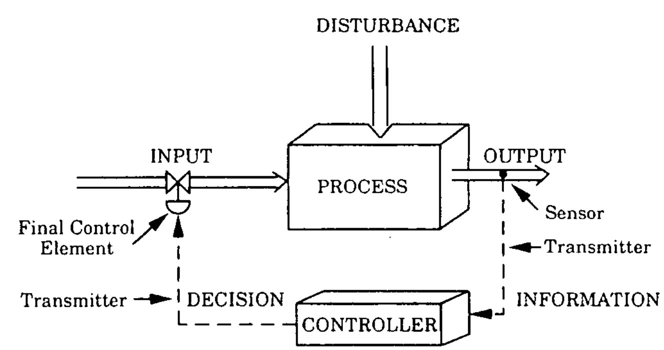

Figure 1.12. The feedback control configuration.

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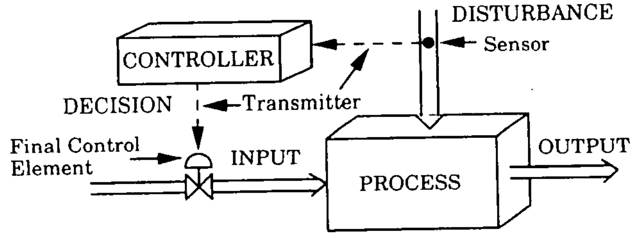

Figure 1.13. The feedforward control configuration.

It is important to point out the intuitively appealing nature of this control structure. Observe that it makes use of *current* information about the output of the process to determine what action to take in regulating process behavior. We must note, however, that with such a structure, the effect of any disturbance entering the process must first be registered by the process as an upset in its output before corrective control action can be taken; *i.e.*, controller decisions are taken "after the fact."

Feedforward Control

In Figure 1.13 we have a situation in which it is information about an incoming disturbance that gets directly communicated to the controller instead of actual system output information. With this configuration, the controller decision is taken *before* the process is affected by the incoming disturbance. This is the *feedforward control* structure (compare with Figure 1.12) since the controller decision is based on information that is being "fed forward." As we shall see later, feedforward control has proved indispensable in dealing with certain process control problems.

The main feature of the feedforward configuration is the choice of measuring the *disturbance* variable rather than the output variable that we desire to regulate. The potential advantage of this strategy has already been noted. Further reflection on this strategy will, however, also reveal a potential drawback: the controller has *no information* about the conditions existing at the process output, the actual process variable we are concerned about regulating.

Thus the controller detects the entrance of disturbances and before the process is upset attempts to compensate for their effects somehow (typically based on an imperfect process model); however, the controller is unable to determine the accuracy of this compensation, since this strategy does not call for a measurement of the process output. This is often a significant disadvantage as was noted in Section 1.2.

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Open-Loop Control

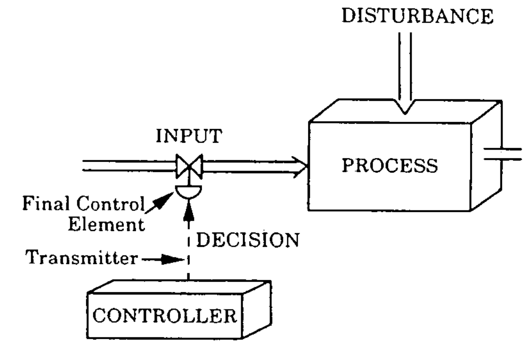

Figure 1.14. The open loop control config

information that "closes the loop" between the output
the process, as is the case with the feedback control co
1.12.) This otherwise vital loop is "open." However, th
constitute a handicap.

Perhaps the most common example of an open-loop
found in the simple timing device used for some traffic li
volume of traffic, the timer is set such that the period
light remains green, yellow, or red is predetermined.

We shall study these and other control system struc
later.

1.4.3 Some Additional Control System Termi

Important process variables that have been selected to r
the control system typically have target values at which
be maintained. These target values are called *set-point*
process variables at their prescribed set-points is, of cour
of the process control system, be it manual or automat
variables deviate from their set-points:

1. Either as a result of the effect of disturbances, or
2. Because the set-point itself has changed.

We have *regulatory control* when the control system's
counteracting the effect of disturbances in order to main
set-point (as was the case in the furnace example of Se
objective is to cause the output to track the changing set
control (see Figure 1.15.)

1.5 OVERVIEW OF CONTROL SYSTEM DE